
Appendix C: Meridian 1 CPU capacity engineering

The preferred way to perform Meridian 1 CPU capacity engineering is to use the Meridian Configurator. If, for some reason, you are unable to use the Meridian Configurator, this appendix provides procedures, scenarios, and examples to enable you to perform engineering calculations.

Meridian 1 CPU capacity

You should engineer the Meridian 1 system to the *rated real-time capacity* of the CPU, which corresponds to the CPU being used 2520 seconds out of a busy hour. (The value of 2520 seconds represents 70% of the maximum value and makes allowance for peaks in traffic during busy hours.)

An *Equivalent Basic Call* (EBC) is an internal, non-featured, 2500-set-to-2500-set call, and represents the simplest call setup and tear-down functions performed by the CPU. An EBC is used as the unit to represent the constant, maximum call capacity of a CPU. For any application with features, the rated call capacity is actually a smaller number of calls per hour, the extent depending upon the number and the combination of features.

Your main objective in performing real-time capacity engineering on the Meridian 1 system is to calculate the real-time call capacity and usage of a given switch, expressed in EBC. Then you can estimate the expected use and spare capacity.

If the CPU of interest is not listed in Table 15, refer to Table 1 to estimate its capacity. For a Gemini processor (ST or Option 11), you must multiply the value 68,000 EBC per hour of an Option 81 by 0.12 to obtain the rated call capacity of 8,160 EBC per hour.

Real time impact of a feature is computed in terms of Equivalent Basic Calls (EBC). One EBC is equal to the real time used by processing one basic call.

The real-time impact of a feature can be expressed in EBC by dividing the real-time difference between the basic call and the feature by the basic call. The result is called the “real-time factor” of the feature. It is the additional real time required by a featured call compared with the real

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time required by a basic (non-featured) 2500-to-2500 set call. The real time factor is always expressed in units of EBC.

The CPU real time rated capacity in EBC are summarized in Table 15 for Release 18 through 22. The number quoted here is for EPE hardware. With IPE hardware, there is some improvement (roughly 15-25% depending on release). EPE is the old hardware, which does not have local processing intelligence, as the IPE (Intelligent PE) does.

Should a calculation involve a system with earlier Release software, users should refer to the *Meridian 1 Capacity Engineering* (NTP 553-3001-149) for corresponding rated capacity and real-time factors.

Table 15
Meridian 1 CPU rated capacity in EBC (Release 18 to 22) with EPE

Meridian Option	11/11E	11C	21E	51/61/71	51C/61C/ 81C (CP1)	51C/61C/ 81/81C (CP2)
Rls 18/19	12,240	N/A	25,840	31,960	68,000	N/A
Rls 20	8,892	N/A	18,772	23,218	49,400	N/A
Rls 21	8,100	N/A	17,100	21,150	45,000	70,650
Rls 22	N/A	46,800	N/A	N/A	40,000	62,800

The capacity ratios between machines are based on that of Table 1. They do not always stay constant from release to release; therefore, the quoted capacity in Table 15 may not be identical to some earlier publications. The variations are generally not very significant (less than 10%). This document is meant to illustrate the engineering procedure. The approximation is close enough for planning purposes. For a more precise calculation, users are referred to the Meridian Configurator which covers all configuration alternatives in greater details.

The EBC rating of a CPU is the absolute maximum number of basic calls allowed in a system. The actual call capacity of a practical system with applications will be significantly less. The real time of a typical CCR call is approximately within the range of 2 to 5 EBCs.

Real-time factors for complicated features

For a complex call, the impact of the entire call can be computed simply by adding together the incremental impact (in EBC) of each feature involved, plus 1 EBC for the basic call.

Real time factors for some features are slightly different for various Meridian 1 Options. To avoid using one set of factors for each machine type, the prevailing set of real-time factors, which has been adopted for Meridian Configurator, is primarily based on measurement of the Option 81 CPU, which may on occasion differ from some published numbers for other machine types (after taking into account the speed factor of the two CPUs). The deviation is considered to be slight and may be ignored.

Some frequently used real-time factors are summarized in Table 16.

Table 16 is applicable to all CPUs, provided that the CPU type and release number are consistent. For example, you must use real-time factors from Release 21 or later to calculate CP2 capacity since the CPU is not compatible with earlier releases. Refer to Table 15 to check the consistency of release versus CPU.

Table 16
Real-time factors in EBC for call center features (a 2500 set-to-set call generates 1 EBC)

Features	Real-time factors in EBC				
	Rls 18	Rls 19	Rls 20	Rls 21	Rls 22
Digital set call	0.22	0.26	0.21	0.14	0.14
Incoming ACD (Digital)	0.81	1.03	0.42	0.42	0.46
Outgoing ACD	0.50	0.50	0.50	0.50	0.50
CCR/HER	0.91	0.91	0.91	0.91	0.91
NACD overflowed call	2.89	2.89	2.89	2.89	2.89
Meridian Link	0.08	0.08	0.38	0.38	0.38
Meridian Link with transfer	1.72	1.72	1.72	1.72	1.72
MIVR	-	0.51	0.51	0.51	0.51
MIVR with transfer	-	1.78	1.78	1.78	1.78
MAX	0.32	0.56	0.81	0.81	0.81
RAN + MUS	1.07	1.07	0.98	0.98	0.98
MM (CSL) call	1.42	1.73	1.05	1.05	1.05
MM (EES) call	4.06	1.77	1.74	1.74	1.74
CDR record (inc.)	0.98	1.17	0.60	1.25	1.28
CDR record (out.)	1.51	1.17	0.44	1.09	1.11

CDR record (int.)	1.24	1.79	0.68	1.49	1.47
Preview/Predictive dialing	0.50	0.50	0.50	0.50	0.50
Answered Preview/Predictive dialing	1.72	1.72	1.72	1.72	1.72
Meridian 911	-	1.41	1.41	1.41	1.41
CCR Statistics Message (on; 1 message/4 seconds): 54 EBC/ACD-DN/hour					

When real-time factors for a later release are not available, use real-time factors of the previous release

Some important rules and assumptions need to be followed to use this table. Note that all examples use Release 18 figures unless otherwise specified; the same procedure with proper real-time factors should be substituted for later releases:

- When real-time factors for newer releases are not measured, the same real-time factor as the previous release is used.
- The default value for a CCR call is an incoming call terminating on a CDN, which is put on two ACD-DN queues for 18 seconds (three rings time), and then answered by an agent.
- Predictive Dialing is a host generated outgoing call which is transferred to an agent, once it has been answered by a subscriber or customer in a CO.
- An unanswered Predictive Dialer call is treated like a simple outgoing ACD call. An answered Predictive Dialer call includes Meridian Link transfer.
- A more complicated script for CCR/HER/M911 will cost a multiple of real-time factors used for a typical scenario. A range of from one additional real-time factor (0.91 EBC) over an incoming ACD to three (3 x 0.91 EBC) appears to cover most practical applications.
- Every incoming call to the agent is assumed to be digital. The effect of the digital set has been built into the real-time factor (0.81) for an incoming ACD call.
- The factor for the digital set will be used only for internal digital set calls; there is no need to add it to an ACD call as explained above.
- A CCR call is built on top of an incoming ACD call, which in turn is built on top of a basic call. Therefore, the EBC of a complete CCR call in R18 = $1 + 0.81 + 0.91 = 2.72$. A CCR call will use 1 EBC for basic call, 1 ACD (inc.) factor, and 1 CCR factor. If the script is quite complex and the average waiting time per call is long, the CCR factor could be as large as 3 x 0.91 (or 3 x 1.31 for later releases).
- An NACD overflowed call is built on top of an incoming ACD call which also has a basic call as a subset. The EBC of a complete NACD overflowed call in R18 = $1 + 0.81 + 2.89 = 4.70$. An NACD overflowed call will use 1 EBC for basic call, 1 ACD (inc.) factor and 1 NACD factor.

- A Preview/Predictive Dialer (PD) call with transfer is built on top of an Outgoing ACD call which in turn has a basic call as a subset. The EBC of a complete PD transfer call = $1 + 0.50 + 1.72 = 3.22$. A PD call will use 1 EBC for basic call, 1 PD and 1 Answered PD factor.
- A Meridian 911 (Release 19) call is the sum of following components: 1 EBC + 1 inc. ACD + 1 M911 (= $1 + 1.03 + 1.41 = 3.44$ EBC).
- Real-time factors for mutually exclusive features, such as CCR, M911 and NACD are not additive.
- The following real-time factors are usually associated with incoming calls only: CCR, HER, NACD, M911, MAX, RAN/MUS, MIVR, and CDR Record (inc.).
- The following real-time factors are associated with outgoing calls only: Predictive Dialing, and CDR Record (out.).
- The following real-time factor is associated with intra-office calls only: CDR Record (int.).
- The following real-time factors are usually associated with incoming calls or intra-office calls: MM (CSL), and MM (EES). The large difference in real-time factor between Release 18 and Release 19 for MM (EES) is due to the enhancement of removing conference path from EES. Use of this enhancement can have a significant effect on the system capacity. Also note that the MM(EES) for Release 19 and Release 20 can have DTMF turned on or off, the number quoted here is for "off," the less expensive one.
- The RAN + MUS factor is a cycle of RAN and a segment of MUS. It should be multiplied by the number of cycles, if more than one is expected.
- Real-time factors in the same category (inc. or out.) are additive. For example, $CCR + RAN/MUS + MAX + CDR = (1 + 0.81 + 0.91) + 1.07 + 0.32 + 0.98 = 4.99$, represents the EBC of a CCR call with RAN, MAX, and inc. CDR.
- The real-time factor for a transferred MIVR call is the sum of MIVR no transfer plus MIVR with transfer.

- The procedure in this document is different from the Meridian Configurator in two ways: (1) The effect of digital set is included in an Inc. ACD call. (2) To simplify the procedure, the impact of trunk types (tie, PRI, and so on) is ignored. Small variations in results (less than 10%) between manual calculations and Autoquote is expected.
- When the CCR statistics message is turned on, each ACD-DN under the control of CCR will send a statistics message to the CCR module. This will happen every four seconds for queue status updating, resulting in an overhead of 900 messages per hour per ACD-DN to the CPU. A lot of messages are sent “piggy-backed” with regular message. Therefore, the additional messages for statistics are estimated to be 540 per DN per hour. By assuming the real time for 10 messages is equal to an EBC, the overhead in EBC for a DN is 54. No real-time overhead needs to be added if status message is turned off from an ACD-DN.
- A warning: All real-time factors for featured calls are based on some basic scenarios of that specific application. A complicated script (in CCR, HER, and so on) may significantly increase the real time required by that feature. The factors in Table 16 are considered “typical” for these applications, but users should use them with caution.

For general non-Call-Center applications, a more detailed breakdown among incoming, outgoing and internal calls is required (in which case, intra-office ratio and tandem ratio are required as inputs).

The above real-time values in EBC will be used to estimate the utilization and capacity of a Meridian 1 system. The procedure presented here is simplified for high level manual calculations. Users should refer to Autoquote for more detailed and accurate system engineering.

Real-time calculation procedures

The rated capacity of the Meridian 1 for a busy hour is set according to the EBC number in Table 15 for each machine type. This level will be used to estimate the maximum real-time capacity of the Meridian 1 system and the spare capacity of a given application, if any.

The calculation procedure is described in the following subsections.

Determine the total system calls

A configuration required by a customer is frequently given as the number of trunks, the number of agents, and the total number of calls the call center has to process in a busy hour. It is recommended that the calls carried by trunks, and the calls processed by agents be calculated to be compared with the call handling requirement of the Center. It is imperative that the three capacities be matched before real-time calculation can proceed.

The general guidelines are as follows: (1) The calls carried by trunks should be equal to or slightly more than call center requirements. (2) The number of trunks in the configuration should be 10 to 50% more than the number of agents, since queued calls occupy trunks, not agents. (3) The number of agents should be able to handle non-overflowed calls of the customer requirement for the call center. (4) Adequate number of Meridian Mail ports should be provided for Meridian Mail related features, such as MIVR and HEVP.

The following procedures can be used to calculate trunk and agent calls, if they are not already specified by a customer.

The number of trunk calls

Trunk calls/hour = Number of trunks x calls/trunk

If the number of calls per trunk is not known, the default number 15.6 calls/trunk can be used, which assumes 28 CCS per trunk with an average holding time of 180 seconds.

The number of agent calls

Agent calls/hour = (Number of agents) x (calls/agent)

If the number of calls per agent is not known, the default number 18.3 can be used, which assumes 33 CCS per agent with an average service time of 180 seconds.

The call capacity required by the customer

The call capacity requirement of a call center is frequently set by the customer. It is important for you to verify that the call capacity requirement can be met by the number of trunks equipped and agents provided.

When the call capacity is given, it should be used to calculate the system EBC. If it is not known, the number of calls carried by trunk groups should be used to estimate CPU loading.

Convert featured calls to EBC

The real-time factors in the following equations are Release 18 figures. Appropriate numbers from Table 16 should be used for later releases.

Basic calls

Let Ct be the total number of ACD calls.

Basic Calls EBC = 1 EBC x Ct

Every ACD call has one basic call as its basic unit.

Incremental impacts of features

From customer requirements and percentage of call types given, calculate EBC for each feature (from Table 16):

Inc. ACD Call EBC = # of Inc. ACD calls x 0.81

Out. ACD Call EBC = # of Out. ACD calls x 0.50

CCR EBC = # of CCR calls x 0.91

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CDR Record (out.) EBC = # of calls with outgoing CDR x 1.51

CDR Record (int.) EBC = # of calls with internal CDR x 1.24

When a call includes many features, it will generate EBCs for each feature involved.

Other traffic in a call center

An agent supervisor performs administrative functions, assists an agent in dealing with difficult customers and relieves agents when needed. The physical requirement of a supervisor set is no difference from an agent set. However, the traffic requirement is different.

Assuming a supervisor set is digital, if CCS and Holding Time (HT) are known, use the following formula:

Supervisor set EBC = # of calls x 1.81 = (# of sets x CCS x 100/HT) x 1.81,

where 1.81 is the sum of 1 EBC plus 0.81 for the incoming ACD factor.

If the traffic per supervisor set is not specified, we can assume that a supervisor set processes 9.2 calls per hour per set (about half the load of an agent set) by using the following formula:

Supervisor set EBC = (# of sets x 9.2) x 1.81 = # of sets x 16.65.

Other traffic in the system includes calls from administrative sets and non-ACD agents digital sets which can be estimated by using the formula:

Administrative set EBC = # of calls x 1.22 = (# of sets x CCS x 100/HT) x 0.5 x 1.22.
There is a built-in assumption of digital sets and 50% originating and 50% terminating per set.

If the traffic per administrative set is not specified, we can use 6 CCS per set and 150 seconds holding time, which yields the following formula:

Administrative set EBC = (# of sets x 2) x 1.22 = # of sets x 2.44.

Here we assume that the impact of incoming/outgoing calls over intra-office calls for administrative sets is negligible.

When Meridian Mail traffic is associated with incoming ACD calls, we can use the following formula to calculate its EBC:

Meridian Mail EBC = # of calls going to MM x 1.42 (for CSL) or x 4.06 (for EES).

In a call center environment, Meridian Mail is frequently used only in nonACD applications. In that case, we use the following formula:

Meridian Mail EBC = (# of Adm. calls) x (% calls to MM) x 1.42 (or 4.06).

When the percentage of administrative calls going to Meridian Mail is not specified, a default value of 10% (0.1) can be used. The real-time factor for MM includes a built-in percentage for retrieving the message during busy hours.

If the call center is built on top of other non-call center applications, such as a switch serving a significant number of administration personnel (for example, accounting, planning, human resources, research and development), the EBC of the non-call center part must be calculated according to the normal Meridian 1 engineering procedure to be included in the "Others" term of the system EBC formula. The real-time impact of features such as conference, call transfer, ring again, and so on, must be accounted for.

Total system calls in EBC

Finally, the total system EBC is summarized:

System EBC = Basic Call EBC + Inc. ACD Call EBC + Out. ACD Call EBC + CCR EBC + ... + CDR Record (int.) EBC + Supervisor set EBC + Administrative set EBC + 54 EBC x No. of Stat. DN's + Others

This total system EBC is the load the Meridian 1 CPU has to handle.

Calculate spare capacity

Once the system EBC is obtained, compare it with the EBC in Table 15 for the proposed machine type. If the entry in Table 15 is greater than the system EBC, the CPU of the proposed switch has more capacity than the configuration requires. The spare capacity can be calculated as follows:

$$\% \text{ Spare Capacity} = (\text{EBC} - \text{System EBC}) / \text{EBC}$$

If system EBC is greater than the machine EBC, the requirement is more than the CPU can handle. The configuration is limited by the CPU capacity (if not already constrained by other resources, for example, loop or card slot).

Calculate allotted CCR calls in Meridian 1

All the above calculations are given call types (applications) to estimate the Meridian 1 CPU usage and spare capacity. In practical applications, it is possible that existing customers may want to find out whether they have the CPU capacity to add CCR features and also determine how many CCR calls are allowed.

Once the number of allotted CCR calls is estimated, the user can follow the procedure in Appendix D to calculate the module capacity. The smaller of the two (allowed CCR calls in Meridian 1, and CCR module capacity) is the capacity limit of the system.

The following procedure should be used to calculate the allotted CCR calls.

- 1** Determine spare CPU capacity in the Meridian 1.
Use the above calculations or the TFS004 of the traffic report of an existing switch to determine the percentage of spare capacity available to carry CCR traffic.
- 2** Convert spare capacity to EBC.
Depending on the type of CPU involved, convert the percentage spare to available EBC. For example, if the system is an Option 81 CP1 with Release 19 software, and the spare capacity is 30%, the available EBC for CCR is $68000 \times 0.30 = 20,400$ EBC.
- 3** Convert EBC to CCR calls.
Follow the procedure in the "Real time calculation procedures" section of this appendix. The number of CCR calls using a simple script can be calculated as follows:
$$\text{CCR calls} = 20,400 / (1 + 1.03 + 1.31) = 6,107.$$
This number is referred to as "capacity of the Meridian 1 system allotted to CCR" in Appendix D. Similar calculations can be performed for typical or complex CCR scripts.

Engineering examples

Real time factors used in the following examples are specified as shown. If not specified, the default Release is 18. The loop and card slot calculations are illustrated in Examples 1 and 2. The rest of examples deal with the CPU capacity calculation procedure.

Example 1: A call center with MIVR including physical capacity (Release 22)

A proposed new Release 22 site with 192 Agents, 15 supervisors, 195 PRI trunks and 45 analog trunks requires the switch to handle 4,800 incoming ACD calls in the busy hour. All calls first terminate on 32 MIVR ports.

30% of total calls will experience some delays and listen to a cycle of RAN and a segment of music before reaching MIVR. After that, 70% of total calls are transferred to live agents after listening to IVR messages for 15 seconds, and the remaining 30% are satisfied with voice menu information. 100 administrative sets (all digital) with 6 CCS per set handle non-ACD calls. About 10% of administrative set calls generate messages to Meridian Mail. Average holding time is 132 seconds for all serviced calls.

Which Meridian 1 option should be equipped to handle this configuration? And with what type of CPU?

Solution:

Since Release 22 software is required for this customer, only "C" model machines are qualified for this site. It is not obvious whether Option 11C has the physical capacity to accommodate the required ports. If it turns out to require an Option 61C or 81C, we also need to determine what CPU (CP1 or CP2) is required to meet call handling requirement.

1. Card slot/Loop requirement

a. Card slot calculation for Option 11C

$N1 = [L / 16] + [T / 8] = [(192 + 15) / 16] + [45 / 8] = 13 + 6 = 19$;
card slots for agent sets and analog trunks

$N2 = [L / 16] + [(T + 2) / 24] = [100 / 16] + [(195 + 2) / 24] = 7 + 9 = 16$;
card slots for digital admin sets and PRI trunks

$N3 = 1$ (for RAN / Music) + 1 (for Meridian Mail) = 2;
card slots for applications

$Nt = N1 + N2 + N3 = 19 + 16 + 2 = 37$

The required number of card slots, 37, is greater than 29. This configuration exceeds the physical capacity of an Option 11C.

b. Loop requirement for Option 51C/61C/81C

$N0 = [100 \times 6 / 660] = 1$; loops for admin. sets

$N1 = [(192 + 15 + 45) / 30] = 9$; loops for agent, supervisor sets and analog trunks

$N2p = [(195 + 2) / 24] = 9$; loops for PRI trunks

$N32 = [32 / 16] = 2$; loops for Meridian Mail (MIVR) ports

Total required loops = 1 + 9 + 9 + 2 = 21

The number of loops required is greater than 14 but less than 28, it exceeds the capacity of an Option 51C and is within the capacity of an Option 61C.

2. Real Time Requirement

Use call processing requirement (4800 calls/hour) to calculate expected CPU load.

Real Time Requirements:

Basic Call EBC = 1 x 4,800 = 4,800 EBC

ACD EBC = 4,800 x 0.46 = 2,208 EBC

Music EBC = 4,800 x 0.3 x 0.98 = 1411 EBC; factor 0.98 for RAN + MUS

MIVR EBC = 4,800 x 0.51 = 2,448 EBC; MIVR treatment for all calls

MIVR with transfer EBC = 4,800 x 0.7 x 1.78 = 5,981 EBC

Supervisor set EBC = $(15 \times 9.2) \times 1.46 = 202$ EBC; factor = $1 + 0.46$

Adm. set EBC = $(100 \times 6 / 1.32) \times 0.5 \times 1.14 = 259 \times 1.14 = 296$ EBC; factor = $1 + 0.14$
for digital admin set call; 50%-50% split for originating and terminating

Meridian Mail Call EBC = $259 \times 0.1 \times 1.05 = 28$ EBC; CSL signaling for Meridian Mail

Total system EBC = $4,800 + 2,208 + 1,411 + 2,448 + 5,981 + 202 + 296 + 28 = 17,374$

For Release 22, among Option 11C (at 46,800 EBC), 61C CP1 (at 40,000 EBC) and 61C CP2 (at 62,800 EBC), any CPU is able to handle the required EBC. Since Option 11C cannot accommodate port requirements, we recommend Option 61C CP1 to serve this customer.

% CPU usage = $17,374 / 40,000 = 44\%$

Spare CPU capacity = $1 - 0.44 = 56\%$

Using an average holding time per call is an approximation. It may affect the number of MIVR/MM ports provided and incoming trunks required; it will not impact the loading on the Meridian 1 CPU.

Result:

This call center can be served by a Meridian 1 Option 61C with CP1. The CPU will be loaded 44% of the rated capacity at the proposed traffic level and configuration.

Example 2: A call center with CCR and Meridian Link co-residency including physical capacity (Release 22)

230 inbound agents, 10 outbound agents, 22 supervisors, 300 PRI trunks, 50 analog trunks

The center must support 4000 inbound calls and 1500 outbound calls per hour. The outbound calls are placed by 45 2500-type lines, controlled by a predictive dialing application connected through Meridian Link to a host and the Meridian 1. Only 10% of the calls are answered and transferred to a live agent. All inbound calls terminate on two CDN's controlled by CCR. There are 100 administrative digital sets with 6 CCS per set. Average holding time per call is 150 seconds. The same AML is shared (co-residency) by CCR and ML messaging. Determine the data link requirements. The CCR is drawing statistic messages from all 5 ACD-DN's in the system.

Solution:

1. Loop/card slot Requirement

$N0 = [(100 \times 6 + 50 \times 28) / 875] = 3$; 50 analog trunks are placed in this superloop

$N1 = [(230 + 10 + 22 + 45) / 30] = 11$; autodialer ports also require non-blocking

$N2 = [(300 + 2) / 24] = 13$; loops for PRI trunks

Total network loops required = $3 + 11 + 13 = 27$. It is within the capability of an Option 61.

To determine whether this configuration can be handled by an Option 11C, perform the following card slot calculation:

$N1 = [L / 16] + [T / 8] = [(230 + 10 + 22) / 16] + [50 / 8] = 17 + 7 = 24$; card slots for agent sets and analog trunks

$N2 = [L / 16] + [(T + 2) / 24] = [(100 + 45) / 16] + [(300 + 2) / 24] = 10 + 13 = 23$; card slots for digital admin sets, autodialer ports and PRI trunks

$N3 = 1$ (for CCR/AML); card slots for applications

$Nt = N1 + N2 + N3 = 24 + 23 + 1 = 48$

The number of Option 11C card slots required to handle this configuration is 48 which is greater than the available slots of 29 for the machine. This site requires an Option 61C.

Note that because of non-blocking network in Option 11C, in general, an Option 61 can support more ports than an Option 11C does. If loop calculation indicates that an Option 61C is not sufficient to support a given configuration, there is no need to try Option 11C for the same site.

2. Real Time Requirement

Basic Call EBC = $1 \times (4,000 + 1,500) = 5,500$ EBC

Inc. ACD EBC = $4000 \times 0.46 = 1840$ EBC

CCR EBC = $4,000 \times 0.91 = 3,640$ EBC

Out. ACD EBC = $1,500 \times 0.50 = 750$ EBC

Predictive Dialing EBC = $1,500 \times 0.10 \times 1.72 = 258$ EBC

Supervisor set EBC = $22 \times 9.2 \times 1.46 = 296$ EBC

Administrative set EBC = $(100 \times 6 / 1.5) \times 0.5 \times 1.14 = 228$ EBC

Statistic message EBC = $5 \times 54 = 270$ EBC

Total EBC used = $5,500 + 1840 + 3,640 + 750 + 258 + 296 + 228 + 270 = 12,782$.

From Table 15, the capacity EBC of 61C CP1 is 40,000, which is quite sufficient to handle the given real time requirement.

Loading = $12,782 / 40,000 = 32\%$

3. Data Link Requirements

The number of Predictive Dialer calls is 1,500, the number of CCR calls is 4,000, the number of ACD DN's drawing statistic messages is 5. By using the following formula, the equivalent AML calls per hour can be obtained:

Equivalent ML Calls/Hour = ML calls $\times$ 1.0 + CCR calls $\times$ 1.2 + 54 $\times$ No. of Stat. ACD-DN's = $1500 \times 1.0 + 4,000 \times 1.2 + 54 \times 5 = 6,570$.

A data link with 9600 bps data rate is required to handle 6,570 calls.

For a better grade of service, a link of 19,200 bps is normally equipped as a standard initial installation for AML applications.

4. Result

The required configuration can be handled by an Option 61C. The projected CPU load is 32% of the rated capacity. A data link with 9,600 bps rate is needed for the combined Meridian Link and CCR (co-residency) applications, although recommended default link rate is 19,200 bps.

Example 3: Inbound call center (MM/MAX/CDR) (Release 18)

73 Agents, 5 supervisors, 64 PRI trunks, 22 analog trunks.

There are also 21 TIE trunks to two other centers through NACD interflow. The center must support 2000 inbound calls per hour. 25% of the calls are interflowed to the two other centers. There are 48 administrative sets with 6 CCS per set. Meridian Mail (8 ports) is used for non-ACD applications. A MAX is included in the Center, every call has a CDR record and 35% of calls served have to go through RAN (8 trunks) and Music (30 channels) while queuing. Average holding time per call is 120 seconds. What size Meridian 1 should be provided?

Solution:

Real-time Requirements

Basic Call EBC = $2,000 \times 1 = 2,000$ EBC

Inc. ACD EBC = $2,000 \times 0.81 = 1,620$ EBC

NACD Overflowed Call EBC = $2,000 \times 0.25 \times 2.89 = 1,445$ EBC

RAN/MUS traffic in EBC = $2000 \times (1 - 0.25) \times 0.35 \times 1.07 = 562$ EBC

MAX EBC = $2000 \times 0.32 = 640$ EBC

CDR Record (inc.) EBC = $2,000 \times 0.98 = 1,960$ EBC

Supervisor set EBC = $5 \times 9.2 \times 1.81 = 83$ EBC

Administrative set EBC = $48 \times 6 / 1.2 \times 0.5 \times 1.22 = 120 \times 1.22 = 146$ EBC

Meridian Mail Call EBC = $120 \times 1.42 \times 0.1 = 17$ EBC (assuming 10% of non-ACD calls are being diverted to Meridian Mail boxes with CSL signaling)

Total EBC used = $2,000 + 1,640 + 1,445 + 562 + 640 + 1,960 + 83 + 146 + 17 = 8,473$

% CPU usage = $8,473 / 31,960 = 27\%$

Since this is a Release 18 site, and Option 11E and 21E cannot accommodate the configuration physically, an Option 61 is required.

Result

The required configuration exceeds the capacity of an Option 21E in the card slot limitation. An Option 61 is required which provides plenty of spare capacity for future growth.

If this is a Release 22 site, card slot calculation (as illustrated in example 1) will indicate that the total card slot required is about 17, which can be accommodated by an Option 11C with one expansion cabinet.

Since an Option 11C CPU has more capacity than an Option 61C CP1 does, as long as the physical capacity of an Option 11C is not limiting, it can always take the place of an Option 61C/CP1.

Example 4: Inbound call center with MIVR (Release 19)

A call center has 285 agents, 30 supervisors, 565 trunks of which 358 are digital. All calls go to IVR first. Meridian IVR has 5 ACD DN's, 64 "agents" (simultaneous sessions), and is connected through cluster controllers to an IBM mainframe. Assume that 80% of the calls are transferred to live agents; 20% remain in IVR. Assume the average holding time in MIVR for transferred calls is 10 seconds, and held calls is 120 seconds. Average live agent ACD call holding time is 132 seconds. The Center must support 7,000 calls per hour on the ACD side.

Assume that CCR controls 70% of the calls transferred to live agents from the MIVR, with the rest coming straight into ACD DN's. There are also 100 administrative sets, with an average load of 6 CCS per set for both internal and external calls. Meridian Mail is used for internal and external purposes by administrative set calls, which share ports with the MIVR.

What size of Meridian 1 should be provided for this call center and what is the estimated CPU loading? What is the estimated percentage of CPU loading?

Solution:

Real-time Requirements:

This example did not state how many calls are coming from CO during busy hours. We will use the number of trunks and the default number of calls per trunk to calculate offered traffic. Note that one way to validate this approach is to check whether 80% of this traffic source is greater than 7,000 agent-handled calls. The result of the test is positive ($= 7,000 / 0.08 = 8,750$), since the next paragraph shows that the number of trunk calls is slightly larger than this number.

Total calls to MIVR and the system = $565 \times 15.6 = 8814$ calls/hour (assume 15.6 calls per trunk). In this example, the offered calls to the system are defined by the number of fully loaded trunks, not calls handled by agents and supervisors. Since calls from trunks should include everything, the supervisor sets will not add additional calls to the total trunk calls. Since MIVR is a Release 19 feature, the real-time factor of Release 19 in Table 16 will be used. This rule applies to HEVP also.

Basic call EBC = $8,814 \times 1 = 8,814$

Inc. ACD EBC = $8,814 \times 1.03 = 9,078$

MIVR EBC = $8,814 \times 0.51 = 4,495$

MIVR with transfer EBC = $8,814 \times 0.8 \times 1.78 = 12,551$

CCR calls EBC = $(8,814 \times 0.8) \times 0.7 \times 1.31 = 6,466$

Admin set EBC = $(100 \times 6 \times 0.5 \times 100/120) \times 1.26 = 250 \times 1.26 = 315$ (120 seconds HT for admin sets)

EBC for Meridian Mail = $250 \times 0.1 \times 1.73 = 43$ (10% of admin calls go to Meridian Mail)

RAN/MUS EBC = $(8,814 \times 0.8) \times 0.7 \times 0.2 \times 1.07 = 1,077$ (20% of CCR calls require RAN/MUS)

Total system EBC = $8,814 + 9,078 + 4,495 + 12,551 + 6,466 + 315 + 43 + 1,077 = 42,839$

This EBC exceeds the CPU capacity of an Option 71. An Option 81 is required.

% CPU utilization (Option 81) = $42,839/68,000 = 63\%$

Result

An Option 81 is required to provide adequate service for this switch with some spare (37% of rated capacity) for growth.

If the switch software used is Release 22, use real-time factors under Release 22 in Table 16 to calculate EBC usage, and use the EBC of 62,800 in Table 15 for CP2 to calculate CPU utilization. CP1 for Release 22 at 40,000 EBC is not sufficient to handle the required load (42,839 EBC) which becomes slightly higher if Release 22 real-time factors are used to do the calculation.

Example 5: Call center with HEVP and CCR Co-Residency (Release 19)

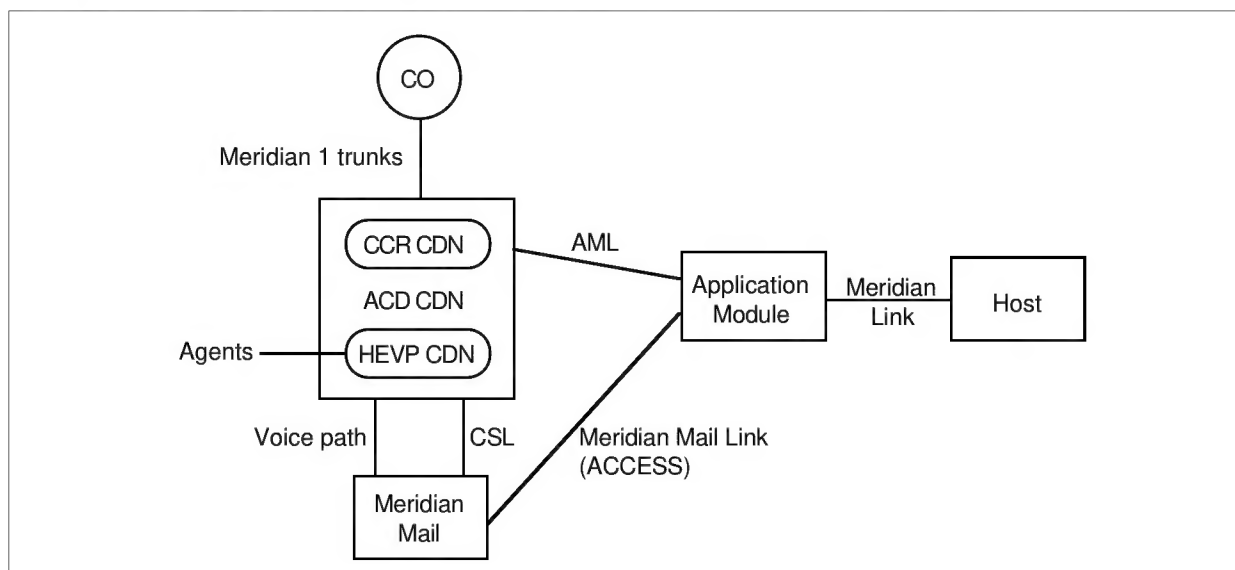
A call center has 480 agents, 50 supervisors, 760 trunks of which 510 are PRI.

20% of all calls go to HEVP CDN first, half of them use voice menu for 90 seconds and disconnect. The other half transfer to live agents after using voice ports for 20 seconds. 60% of the remaining total calls terminate on ACD DN's, and the rest (40%) terminate on CCR CDNs. Assume that the average service time of a call by live agent is 180 seconds regardless of its source. Although there are some shorter calls, because of queues, average holding time per trunk is also 180 seconds.

Questions to be answered: (1) How many incoming calls are to be processed in this scenario? (2) How many Meridian Mail ports are needed to serve this HEVP? (3) Which Option of Meridian 1 is needed to handle this configuration and at what level of CPU load? (4) What data rate is required for the AML serving both CCR and HEVP?

The block diagram of a typical HEVP application is given in Figure 13. Note that the CCR and HEVP applications share the same AML. When the number of calls is not specified by a customer, traffic carried by the fully loaded trunks is the maximum load the call center handles. The default value of 28 CCS per trunk with an average of 180 seconds holding time will be used.

Figure 13
A simplified HEVP/CCR configuration



Solution:

This scenario is simplified to concentrate on HEVP related issues and co-residency only. Other applications demonstrated earlier can be combined with the HEVP feature to give a complete picture of a call center application.

Each area of calculation is illustrated by the following:

Total System Calls

The default CCS per trunk is 28; therefore, the rate of calls per trunk is 15.56
(= 28/1.8).

Total incoming ACD calls/hour = 760 x 15.56 = 11,826

$$\text{HEVP CDN calls} = 11,826 \times 0.2 = 2,365$$

$$\text{HEVP calls with transfer} = 2,365 \times 0.5 = 1,183$$

$$\text{CCR CDN calls} = 11,826 \times (1 - 0.2) \times (1 - 0.6) = 3,784$$

HEVP Ports

Traffic calculation:

$$\text{CCS} = (2,365 \times 0.5 \times 90 + 2,365 \times 0.5 \times 20)/100 = 1,301$$

Based on Table 4, the Meridian Mail Capacity Table, 44 voice ports are needed to handle 1,301 CCS.

CPU Loading

Release 19 real-time factors are used in the following calculations.

$$\text{Basic Call EBC} = 1 \times 11,826 = 11,826$$

$$\text{Inc. ACD EBC} = 11,826 \times 1.03 = 12,181$$

$$\text{HEVP EBC} = 2,365 \times 0.51 = 1,206 \text{ (used MIVR factors for HEVP)}$$

$$\text{HEVP with transfer EBC} = 1,183 \times 1.78 = 2,106$$

$$\text{CCR EBC} = 3,784 \times 1.31 = 4,957$$

$$\text{Total system EBC} = 11,826 + 12,181 + 1,206 + 2,106 + 4,957 = 32,276$$

$$\% \text{ CPU usage} = 32,276/31,960 = 1.04 = 1.04\%$$

Option 71 CPU (from Table 15) is not quite enough to handle this application. An Option 81 with a rated capacity of 68,000 EBC/hour is needed.

$$\% \text{ CPU usage} = 32,276/68,000 = 0.48 = 48\%$$

$$\text{Spare CPU capacity} = 1 - 0.48 = 0.52 = 52\%$$

The Option 81 will have plenty of spare capacity for this customer.

Signaling Link Requirements

Both HEVP and CCR generate more link messages than a typical AML call:

$$\text{Equivalent AML calls} = \text{CCR calls} \times 1.2 + \text{HEVP calls} \times 1.2 = 3,784 \times 1.2 + 2,365 \times 1.2 = 7,379$$

From Table 10, 7,379 AML calls require a data link of 9,600 baud. The ACCESS link (Meridian Mail Link) is a fixed 9,600 baud link. The CSL link to Meridian Mail is a fixed 4,800 baud link. The CCR module is located in the Application Module which has its own database and intelligence for routing control.

For the HEVP application, the same 9,600 baud rate is recommended for Meridian Link. If the default rate of 19,200 bps is to be used for AML, the same rate is also recommended for Meridian Link.